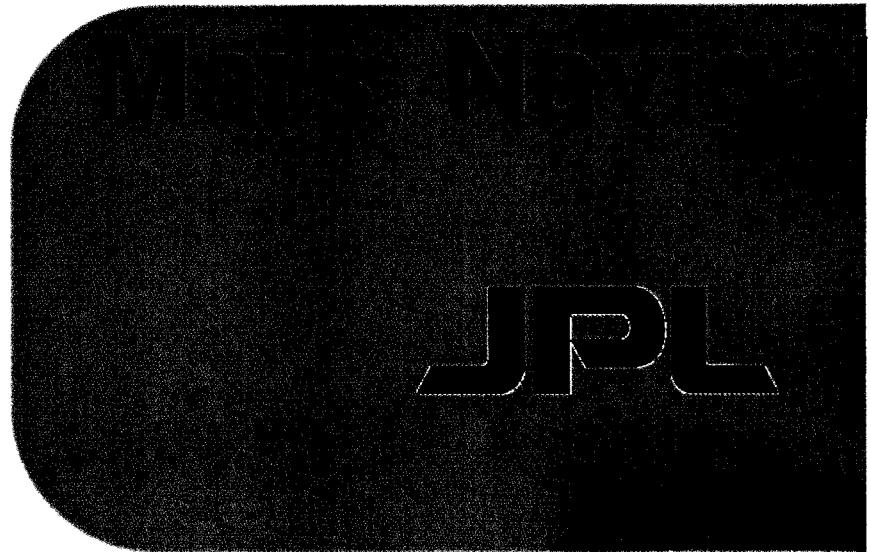


1	2	3
4	5	6

PAGE ORDER FOR POSTER

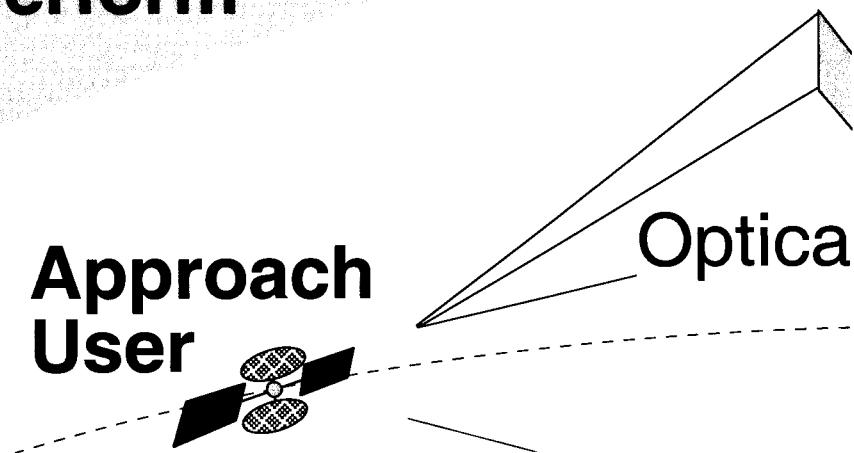
NOTE: This is 40% Reduced Version

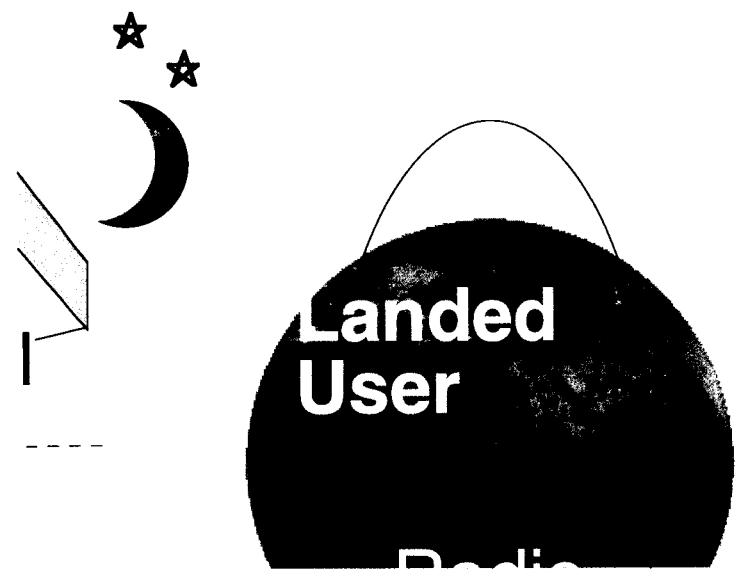
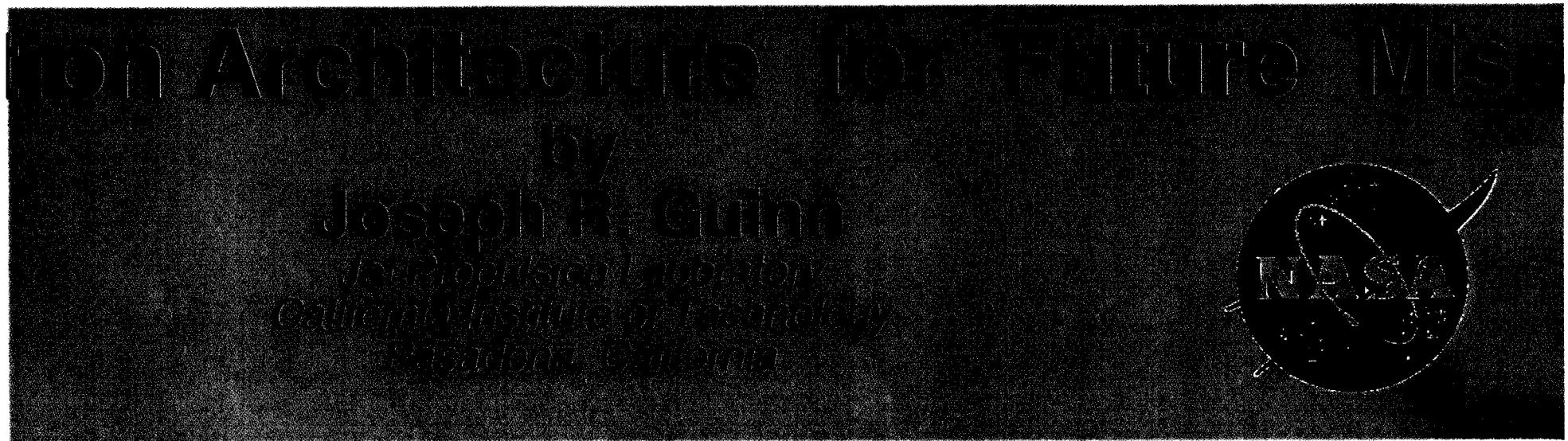
Final will be approximately
1x2 meters



Future Mars Missions will use a variety of Navigation Techniques to Ensure Mission Success and Perform In-Situ Science

Approach
User

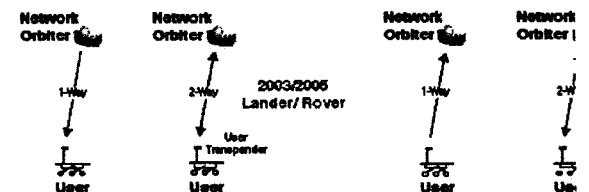




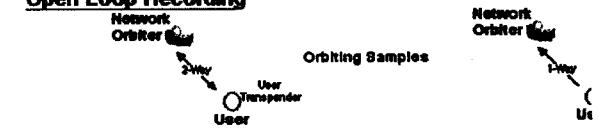
Orbiting
User

In-Situ Radio Frequency Tracking

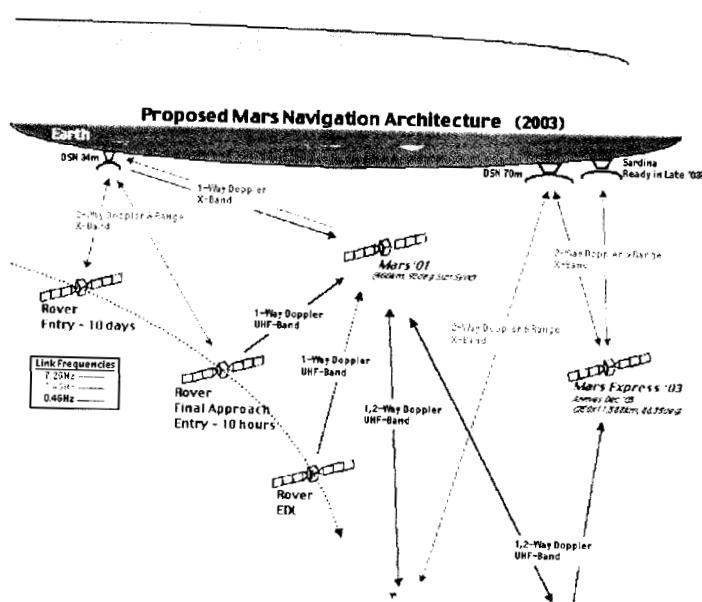
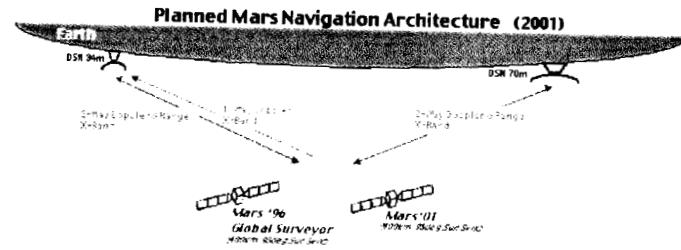
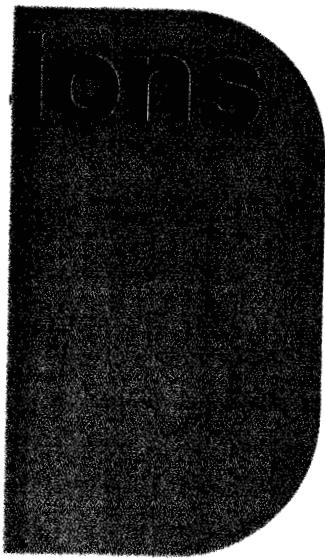
Doppler and Range Observations

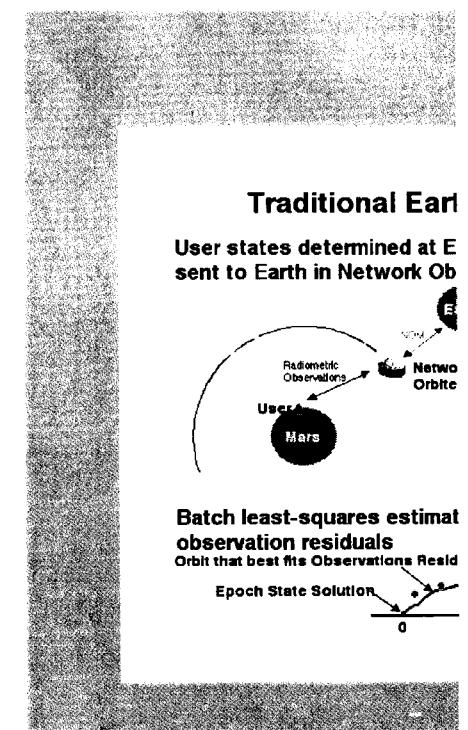
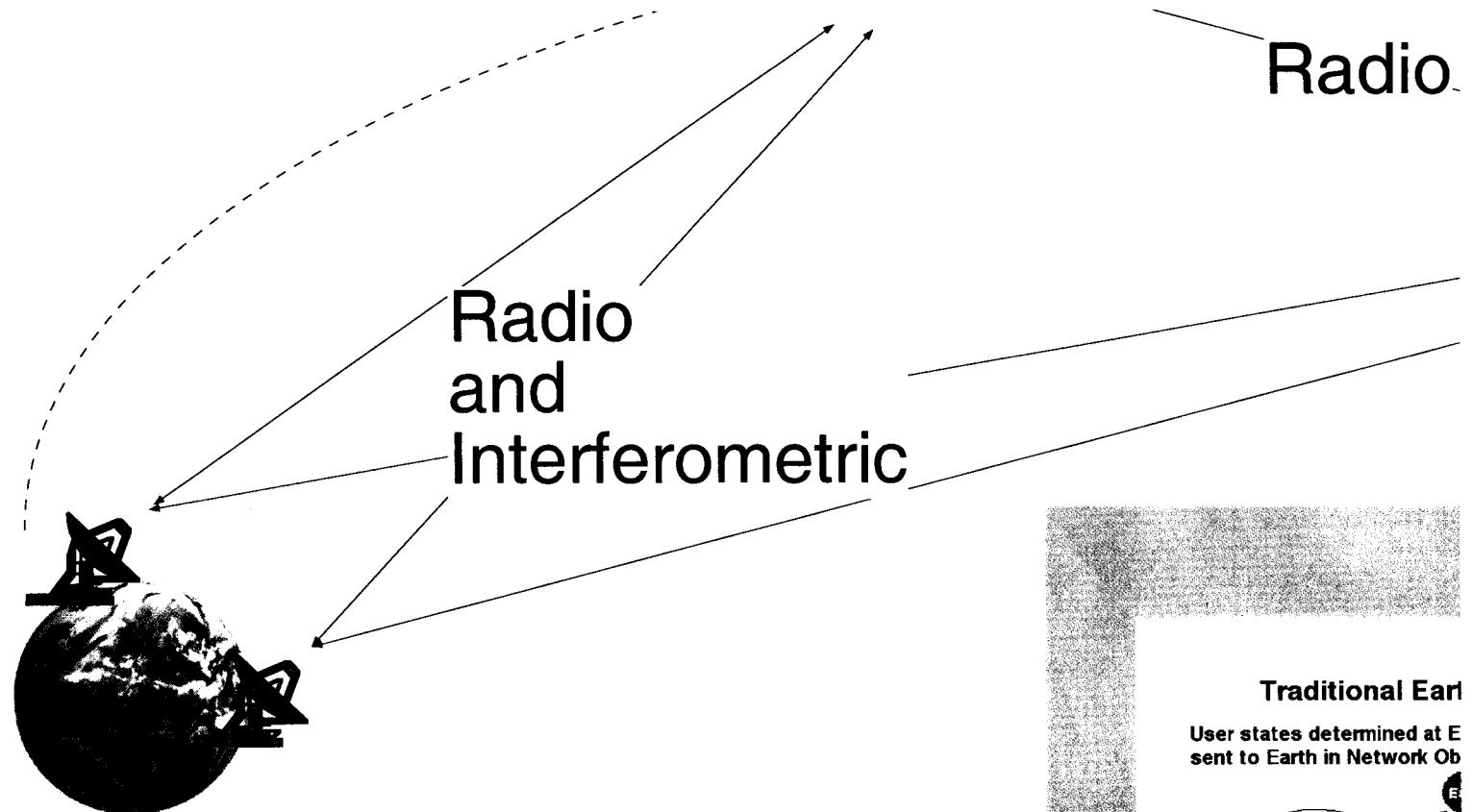


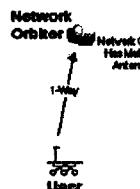
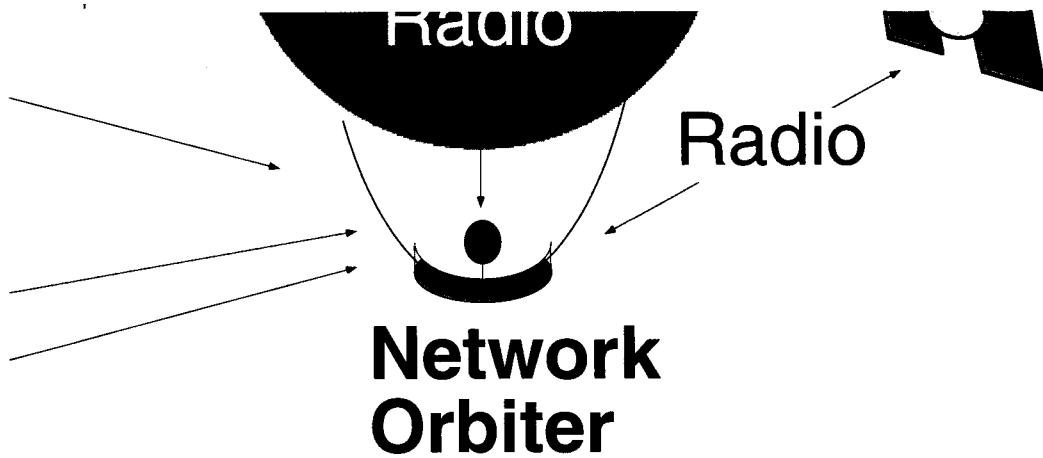
Open Loop Recording



Radio Direction Finding (RDF) Angle Observations







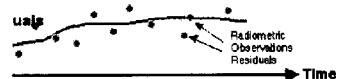
Navigation Message Exchanges

Earth-Based Navigation

Earth from tracking observations
Service Messages (NOM)

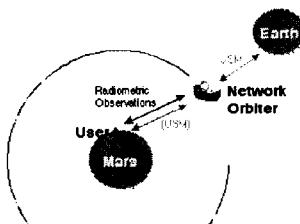
```
Network Observables Message (NOM)
time_type = X, time = xxxxxxxx
transmitter_id = x, receiver_id = x
observation_type x, observation = xxxxxx
where observation_type = 01 for 1-way phase
observation_type = 02 for 2-way phase
observation_type = 11 for 1-way Doppler
observation_type = 12 for 2-way Doppler
observation_type = 21 for 1-way range
observation_type = 22 for 2-way range
observation_type = 41 for azimuth
observation_type = 52 for elevation
```

Selection of user state that minimizes



Network Determined Navigation

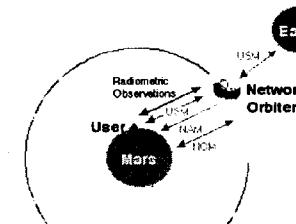
User states determined onboard a Network Orbiter from tracking observations and prior User State Messages (USM). Updated USM's are distributed to Users and to Earth.



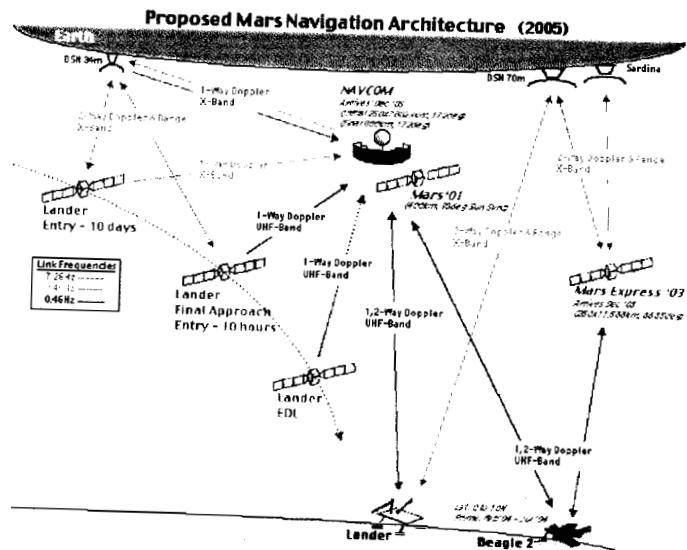
```
User State Message (USM)
User_ID = x
EPOCH = xxxxx.xxx
X = xxxx.xxx
Y = xxxx.xxx
Z = xxxx.xxx
DX = xxxx.xxx
DY = xxxx.xxx
DZ = xxxx.xxx
COVARIANCE = xxxx.xxx.xxx...
Clock Parameters = xxx.xxx
QUALITY FLAGS = x,x
```

User Determined Navigation

User determines own state from tracking observations, prior User State Messages (USM) and Network Almanac Messages (NAM). Updated USM's and NAM's are distributed to Earth.



```
Network Almanac Message
NODE_ID = x
EPOCH = xxxxx.xxx
X_NO = xxxx.xxx
Y_NO = xxxx.xxx
Z_NO = xxxx.xxx
DX_NO = xxxx.xxx
DY_NO = xxxx.xxx
DZ_NO = xxxx.xxx
ClockParameters_NO = xxxx.xxx
COVARIANCE_NO = xxxx.xxx
QUALITY FLAGS = x,x
```



or USM's
are

B (NAM)

XXX

XXX

